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Gongylonematosis of domestic animals under conditions of Ukrainian Polesie and forest-steppe areas

Gongylonematoza zwierząt domowych w warunkach ukraińskiego Polesia i obszarów leśno-stepowych

In the course of studies of the parasitological situation conducted according to the methods elaborated by coworkers of the Department of Parasitology of the Zoological Institute of the Academy of Sciences of Ukraine SSR it was found that *Gongylonema pulchrum* Molin, 1857 is widely distributed among domestic animals. Particularly commonly (almost everywhere) this parasite occurs in the Ukrainian Polesie and to a somewhat lesser degree (in foci) also in other parts of the Ukrainian SSR.

The results of the present studies conducted in meat plants of Kiev (Darnica), Chitomir, Korosten, Lvov, Nikopolsk and Berdyčev, and in slaughter-houses in Ivankovo, Dymir, Radomyśl and Krošno — show that the percentage of cattle (adult animals) invaded with *G. pulchrum* ranges from 32 to 94, of sheep — from 39 to 95, and of pigs from 0 — 37 %.

The intensity of invasion of domestic animals fluctuates within wide limits: from single specimens up to tens and even hundreds of worms in one animal. And so, e.g., in oesophagus of a 7 years old cow which died because of occlusion of oesophagus, 167 mature worms were found. In the Kiev ZOO 203 specimens of *G. pulchrum* were found in a zebu (the animal died because of a diverticle of oesophagus caused by *G. pulchrum*).

In spite of the wide distribution of *G. pulchrum* among the domestic animals and animals in Zoological Gardens, the biology and pathogenicity of this nematode are not well known. It is most likely

that the prevailing up to this date opinion among breeders and some helminthologists that the pathogenicity of this worm is of no major importance contributed considerably towards our limited informations in this respect.

During the past seven years we have been conducting studies in the various seasons of the year examining beetles for the presence of larvae of worms. The beetles were collected on pastures, tracts used by animals, animal sheds and court-yards.

After the identification of the beetle species the following steps were taken: the limbs, wings and chitin shield were removed; the soft parts of the body (internal organs, muscles, fat-body and other parts) were placed between two parts of a glass compressor, pressed and observed by the use of the binocular magnifying prismatic glass or microscope (using low power) for the presence of larvae of worms. One glass compressor could be used for 3 — 20 beetles, depending on their size. The extensity and intensity of invasion of beetles by larvae of worms in various seasons of the year were recorded and the species identity of larvae was determined. In such a way were examined about 48.000 beetles of various species collected in various stages of their development. It was found that 28 species of beetles were invaded with larvae of *G. pulchrum*. They belong to the families *Scarabaeidae* and *Tenebrionidae*: *Geotrupes mutator* Marsh, *G. spiniger* Marsh, *G. stercorarius* L., *Aphodius aestivalis* Steph., *A. subterraneus* L., *A. melanosticus* Schm., *A. fimitarius* L., *A. rufus* Moll., *A. haemorrhoidalis* L., *A. nitidulus* F., *A. sordidus* F., *A. erroticus* L., *A. lugens* Creutz, *A. immundus* Creutz, *A. caspius* Men., *A. satellitus* Hbst., *Onthophagus taurus* L., *O. austriacus* Panz., *O. fracticornis* Preyssl., *O. furcatus* F., *O. nuchicornis* L., *O. vacca* L., *Oniticellus pallipes* F., *O. fulvus* Goetze, *Cacobiusschreberi* L., *Copris lunaris* L., *Amphimallon solstitialis* L., *Blaps lethifera* Marsh.

As far as the available literature shows all the above mentioned species of beetles are for the first time reported to be intermediate hosts of *G. pulchrum* in the Ukraine SSR and USSR. The species: *A. aestivalis*, *A. subterraneus*, *A. caspius*, *A. satellitus*, *A. erroticus*, *A. lugens*, *A. sordidus*, *Copris lunaris*, all representatives of the genus *Geotrupes*, *Oniticellus pallipes*, *O. fulvus*, *Amphimallon solstitialis*, *Blaps lethifera* and others were by us described as intermediate hosts of *G. pulchrum* for the first time.

The number of invasive larvae of *G. pulchrum* in the body of beetles fluctuates within wide limits (1 — 193 specimens). The following regularity was found: the larger the dimensions of the beetle, the more larvae are present in them, and reversely, in smaller beetles the number of larvae is small (1 — 7 — 12). No relation was found between the dimensions of the body of beetles and the dimensions of the body of the invasive larvae. The dimensions of the invasive larvae of *G. pulchrum* in the body of beetles fluctuate within the limits 2.9 — 3.3 mm. They locate themselves in the body cavity, gravitating towards the fat-body and Malpighian tubules. In the body of some of the previously cited beetles were found cysticercoids of tapeworms of birds, acanthellae of *Macracanthorhynchus hirudinaceus* and larvae of *Spirocerca lupi*, *Physocephalus sexalatus* and some time *Ascarops strongylina*. The differentiation of cysticercoids of tapeworms and acanthellae of swine thorny-headed worm from the larvae of *G. pulchrum* presents no difficulties, because they are clearly different organisms. It is, however, difficult to differentiate the larvae of *G. pulchrum* from the larvae of *Spirurata* (*Spirocerca* and *Physocephalus*).

The invasive larvae of *G. pulchrum* are, as already mentioned, of fairly large dimensions of the body (2.9 — 3.3 mm in length and 0.08 — 0.09 thick). The very long, well developed oesophagus attains $\frac{3}{4}$ of the body length. The tail is not provided with spines and distensions. Its terminal end presents a small, barely visible processus. At the distance of 0.132 mm from the terminal end of the body is located the anus, well visible in the form of a fissure. At the distance of 0.219 mm from the anterior part of the body there is the opening of the excretory canal. The oral opening is surrounded by a small trimming in the form of a small funnel. The cuticle which cover the body of the larvae is provided with distinct transversal stripes, particularly well expressed in the tail part.

The length of the body of the invasive larvae of *Physocephalus sexalatus* is 1.1 — 1.5 mm, the width at the thickest part of the body (anterior part) 0.052 — 0.08 mm. The form of the larva is spindle-like. The head part is thicker, the tail part thinner. The terminal part of the tail is provided with the distension and small spines, the number of which fluctuates within the limits from 16 to 21.

The length of the body of the invasive larva of *Spirocerca lupi* is 1.9 — 3.0 mm, the larva is fairly thick (0.072 — 0.122 mm). The oral

opening is surrounded by two lips. On the tail end there is a thickening, the pick of which is covered with small thorns.

Not all the species of the above cited beetles play the same role as intermediate hosts of *G. pulchrum*. This is evidenced by the not uniform extensity of invasion of beetles with larvae of this worm. And so, e. g., the greatest invasions (60 — 90%) were observed in *A. aestivalis*, *A. subterraneus*, *C. lunaris*, *G. spiniger*, *G. stercorarius*, *B. lethifera*, while *A. rufus*, *A. haemorrhoidalis*, *A. fimitarius* and others, as well as also representatives of the genus *Onthophagus* (except *O. austriaca*) and others were invaded to a considerable lesser degree, in spite of the fact that they remained in the same foci as the first listed. On the basis of the observation it can be concluded that in *G. pulchrum*, similarly to many other parasites, they are main — basic intermediate hosts, and hosts of the secondary and tertiary order. We have observed beetles invaded with the larvae of *G. pulchrum* in all the seasons of the year, beginning from the early spring time, summer, up to advanced autumn — that is till the moment the beetles started to hibernate. The degree of invasion of beetles was not uniform in all the seasons of the year. The presence of mature beetles invaded with larvae of *G. pulchrum* in late autumn and particularly in the early spring is undoubtedly an indication that the beetles invaded with larvae of the nematode are able to hibernate. The hibernation of mature beetles containing the invasive larvae of *G. pulchrum* proved that this worm is very well adapted to the conditions of existence. The presence of a large number of final hosts and still greater number of intermediate hosts in *G. pulchrum*, enormous fertility and span of life, preponderance of females over males, high activity and resistance of invasive larvae of this worm to the unfavourable factors of the external environment — all this made it possible for the parasite to gain wide distribution and a leading position among the parasites of domestic animals.

We have found that the invasive larvae of *G. pulchrum* are capable to survive the death and destruction of intermediate hosts — the beetles. Removed from the body of beetle, the larvae are able to live for a long period of time in the external environment and at the moment they are transferred to the final host with food or water they can cause invasion and undergo development into a mature form. Besides this, the invasion of final hosts takes place most likely also after swallowing beetles invaded with invasive larvae of *G. pulchrum*.

In summer we observed in cattle after slaughter in the contents of the stomachs mature beetles of the genus *Aphodius*, invaded with larvae of this nematode.

As shown in the given list of beetles — intermediate hosts, they belong to various ecological groups. More of them are coprobionts, therefore they live mainly in places of concentration and prolonged staying of domestic animals, and in ZOO (on pasture grounds, watering places, breeding farms etc.) where invasion takes mainly place. Besides this, *Blaps lethifera*, as proved by our observations, often lives in sheds of domestic animals and most probably can be the source of invasion of animals in sheds with larvae of *G. pulchrum*.

Invasive larvae of *G. pulchrum* which reached the alimentary tract of the final hosts, locate themselves in the tissues of the oesophageal wall, where they grow. Around the young worms, coiled in the form of spiral, a connective tissue capsule is formed and thus isolates the parasite from the surrounding tissues of the oesophagus. Initially the dimensions of the capsule are not large but simultaneously, with the growth of the worm enclosed in the capsule the dimensions of the capsule increase and attain the size of a large seed of pea. The colour of the capsule is initially pink, later it becomes pale-grey or even white.

G. pulchrum, after attaining sexual maturity, breaks the capsule and passes to the mucous membrane of oesophagus, where it lives moving freely in various directions and can reach the mucous membrane of pharynx, tongue, oral cavity, pylorus of the rumen and sometimes even the omentum. Provided with strong muscles and special chitin structures on the cuticle, the parasite is able to move freely on the mucous membrane of oesophagus and can pierce constantly the living tissues of its host. The most common location of the adult worms is the initial and terminal section of the oesophagus.

The number of females of *G. pulchrum* is greater than that of the males. The body of the mature females contains a very large number of eggs (most probably tens of millions). In the mature eggs there are the larvae. Our studies conducted over the period of the whole year on animals slaughtered in meat plants and abattoirs did not show clearly marked seasonal fluctuations of the degree of invasion of domestic animals. Distinctly marked seasonal „depreciations”, as observed in worms of a short span of life, were not noticed here. This fact, in our opinion, is an indication of longevity of mature nematodes in

the body of their final hosts. We have found that adult animals are more frequently invaded and to a major degree than young animals. This is also an indication of longevity of these worms and of absence of an expressed immunity in gongylonematosi.

No difference was found between the degree of invasion of domestic animals with *G. pulchrum* dependent on the sex and race of hosts. It was only proved that animals which were during the whole year not on pasture grounds were completely free from invasion or were invaded to a mild degree. This was particularly noticeable on the examples of pigs.

As to the intravital diagnosis of animals invaded with discussed nematodes we attempted to find eggs in the faeces of the animals; however, various flotation and sedimentation methods proved to be of small effect. This fact compelled to employ allergic methods to diagnose gongylonematosi in domestic animals.

The allergen for the reaction was prepared in the following way: after the slaughter were collected live mature forms of *G. pulchrum* from the oesophagus of cattle and immediately they were placed in a flask containing sterile physiological solution. In such a state the worms were delivered to the laboratory, where they were several time washed in sterile physiological solution and transferred under sterile conditions into a porcelain mortar where an emulsion was prepared after the addition of physiological solution. The emulsion was filtered through 4 layers of sterile gauze. The liquid obtained in this way was dispensed into sterile containers and submitted to pasteurization. The liquid (emulsion) was tested for sterility and used as the allergen.

The allergic reaction was conducted on 33 heads of cattle. Among the animals 21 were adult animals (7 — 15 years old), and 12 were young, born that year. In the young animals the reaction was always negative.

On cattle the reaction was performed on the 26th of June 1958 in the Meat Plant Darnica. Subsequent control studies were conducted after the slaughter. The results are shown in Table I.

As shown in the Table, all the adult animals reacted in one, or another way to the intradermal introduction of the allergen. The intensity of reaction was not dependent on the degree of invasion of animals at a given moment. For instance, ox No. 3 in which 32 worms were found and ox No. 4 in which after slaughter were found only 7 worms reacted in the same way to the intradermal injection of the same allergen. Ox No. 8 in which altogether no parasites were found, showed a strong allergic reaction. However, young animals which

did not contract yet the invasion with *G. pulchrum*, almost did not react at all to the intradermal introduction of allergen. All this offers a basis to state that the parasitising of *G. pulchrum* in the organism of animals (at least in cattle) leads to sensibilization (allergy) and that the state of the reactivity is maintained even in such cases when in the organism of the animal no worms are present (oxen No. 8 and 16, and cows No. 10, 12 and 17).

Table I

Results of intradermal introduction of allergen and postmortem findings

No.	Sex	Age (years)	Thickness of fold of skin in the place of introduction of antigen			No. of worm in oesophagus
			before introduction of antigen	30' after introduction of antigen	2 h after introduction of antigen	
1	cow	7	5 mm	11 mm	14 mm	31
2	"	8	5 "	8 "	16 "	5
3	ox	8	6 "	8 "	13 "	32
4	"	9	6 "	8 "	13 "	7
5	"	10	7 "	11 "	13 "	9
6	cow	11	6 "	8 "	8 "	2
7	"	8	7 "	10 "	11 "	3
8	ox	7	6 "	15 "	21 "	*
9	"	8	6 "	7 "	10 "	21
10	cow	7	5 "	9 "	10 "	—
11	"	10	5 "	7 "	10 "	25
12	"	6	6 "	7 "	11 "	—
13	"	15	5 "	9 "	10 "	47
14	"	9	5 "	8 "	11 "	3
15	ox	11	8 "	9 "	16 "	23
16	"	12	10 "	21 "	35 "	6
17	cow	15	9 "	10 "	12 "	—
18	ox	9	7 "	10 "	17 "	56
19	"	12	10 "	10 "	11 "	38
20	"	6	7 "	11 "	13 "	9
21	cow	14	9 "	11 "	11 "	—

* traces of parasitizing of *G. pulchrum*.

A positive allergic reaction in adult animals and lack of *G. pulchrum* at the same time deprives the reaction of its value as the method for the detection of invasion, but simultaneously it indicates the important pathogenic role of this parasite.

On the serious influence of *G. pulchrum* on the organism of domestic animals report the works of B a d a n i n and P o p o v a, who describe deep morbid lesions in the tissues of oesophagus of animals invaded with this worm. We have also found in meat plants and slaughter houses in carcasses of animals invaded with this parasite hyperaemia, oedema, and sometimes deformation of oesophagus.

Animals invaded with *G. pulchrum* show symptoms of itch, therefore they often and persistently scratch the itching places. Gongylonematosis is the cause of the occlusion of oesophagus with foreign bodies in cattle and pigs, because the irritation of nervous receptors of the oesophagus leads to dyskinesia of this organ and its reflectory obturation. C h o c h l o v (1958) complains that he was unable to produce experimentally in normal animals (cows) an occlusion of oesophagus even in cases when „to this purpose were used very large potato tubers ($10 \times 8 \times 7$, or $12 \times 10 \times 8$ cm)”. However, in animals invaded with *G. pulchrum* an occlusion of oesophagus can take place even when swallowing considerable smaller objects and sometimes even in the course of eating the usual food (hay, small potatoes etc.).

Sometimes in animals suffering from *G. pulchrum* occurs a paralysis of oesophagus or such a great painfulness of this organ that the animals refrain from taking food. We succeeded to observe even fatal cases of gongylonematosis in cattle.

Veterinary surgeons — husband and wife S. A. and A. J. C h o d o r o v s k i j, workers at the veterinary laboratory in Dondjušan, were as kind as to communicate to us that in November 1957 they observed in a collective farm Vjacenova, district Ataksk, Moldava SSR gongylonematosis which attacked numerous sheep with a fatal course. The leading clinical symptom in the invaded sheep was refusal to take food. Postmortem examination revealed considerable hyperaemia and oedema of the oesophageal wall and the presence of a considerable number of *G. pulchrum* in this organ.

Finally, we feel indebted to convey cordial thanks to A. V. Bogačev and V. G. Pučkov for the assistance shown in the diagnosis of beetles.

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STRESZCZENIE

Autorzy stwierdzili dużą ekstensywność inwazji *Gongylonema pulchrum* u zwierząt domowych Ukrainy: u bydła dorosłego 32 — 94%, u owiec 39 — 95% i u świń 0 — 37%. Intensywność inwazji wahała się w granicach od jednego do kilkuset egzemplarzy pasożyta.

Żywicielami pośrednimi *G. pulchrum* są różne gatunki chrząszczy z rodziny *Scarabaeidae* i *Tenebrionidae*; liczba larw w jamie ciała chrząszcza wynosiła 1 — 193 egz.

Autorzy podają szczegółowe opisy stadiów larwalnych *G. pulchrum* oraz, dla porównania, *Physocephalus sexalatus* i *Spirocerca lupi*, ponieważ w praktyce zachodzi często możliwość mylenia tych gatunków pomiędzy sobą.

Ponieważ kliniczna i koprologiczna diagnoza przypadków gongylonematozy jest właściwie niemożliwa, autorzy wypróbowali również metodę alergiczną. Okazało się, że bydło młode, które nie było jeszcze zarażone *G. pulchrum*, reaguje ujemnie, natomiast bydło starsze, u którego następnie w czasie sekcji stwierdzono obecność nicieni, oraz starsze bydło, które przechorowało gongylonematozę, reaguje dodatnio.

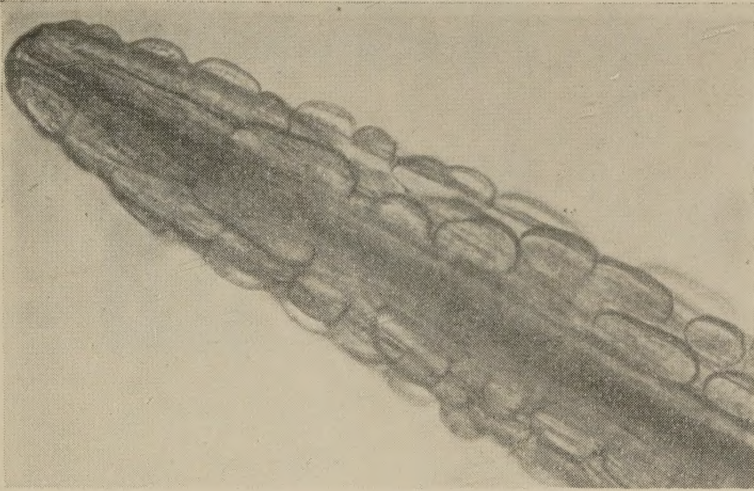
Stwierdzono, że gongylonematoza wywołuje w przełyku przekrwienie i obrzęk, prowadzące do deformacji i zwężenia przełyku, w następstwie czego dochodzi do częstego zatkania przełyku ciałami obcymi.

PLATE I

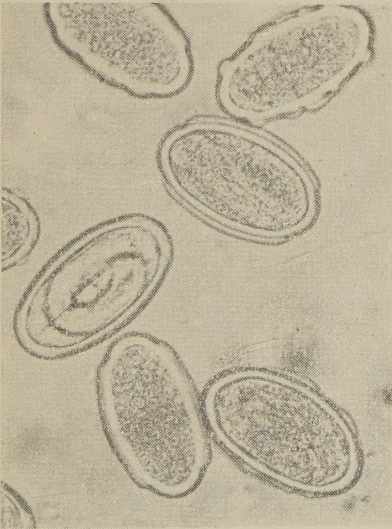
Fig. 1. Head end of adult *Gongylonema pulchrum*.

Fig. 2. Unripe and ripe eggs of *G. pulchrum*.

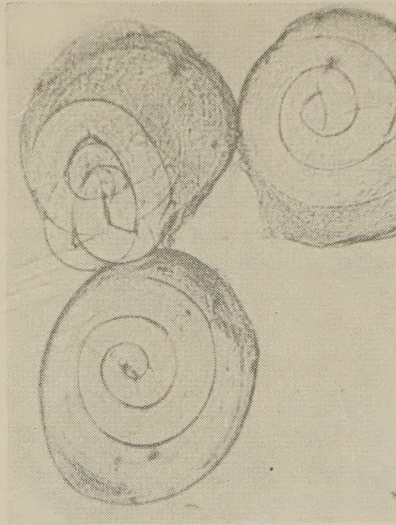
Fig. 3. Larvae of *G. pulchrum* in the body cavity of beetle.



1



2



3

